A1 Sub B1

1. (amended) A clay-polymer nanocomposite comprising an organoclay which has been exfoliated into a polymer matrix, the organoclay being the reaction product of a smectite clay with a quaternary [ammonium] onium compound [which comprises a diester quat.] mixture, wherein the quaternary onium compound mixture comprises a diester quaternary ammonium compound mixed with a triester quaternary ammonium compound, a monoester quaternary ammonium compound, or mixtures thereof; and wherein the organoclay exhibits a decreased D_{001} peak with respect to an organoclay that is the reaction product of the smectite clay with a diester quaternary ammonium compound.

A2

2 ~~4~~. (amended) The nanocomposite of claim 1, wherein the diester [quat] quaternary ammonium compound is present as greater than 55 wt% of the quaternary onium compound mixture.

3 ~~5~~. (amended) The nanocomposite of claim 2 ~~4~~, wherein any triester [quat] quaternary ammonium compound comprises less than 25 wt% of the quaternary onium compound mixture.

4 ~~6~~. (amended) The nanocomposite of claim 3 ~~5~~, wherein the fatty acids corresponding to the esters in the quaternary onium compound mixture have a degree of unsaturation such that the iodine value ("IV") is from about 20 to about 90.

5 ~~7~~. (amended) The nanocomposite of claim 4 ~~6~~, wherein the diester [quat] quaternary ammonium compound content is greater than 60 wt%, the triester [quat] quaternary ammonium compound content is less than 20 wt%, and the IV is from about 30 to about 70.

A2 cont.

6 8. (amended) The nanocomposite of claim 1 5, wherein the diester [quat] quaternary ammonium compound content is greater than 62%, the triester [quat] quaternary ammonium compound content is less than 17 wt%, and the IV is from about 40 to about 60.

A3 Subst. B2

10. (amended) An organoclay [useful in preparing clay-polymer nanocomposites] comprising the reaction product of a smectite clay with a quaternary [ammonium] onium compound [which comprises a diester quat in admixture with further quaternary ammonium compounds having esterified radicals.] mixture wherein the quaternary onium compound mixture comprises a diester quaternary ammonium compound mixed with a triester quaternary ammonium compound, a monoester quaternary ammonium compound, or mixtures thereof; and wherein the organoclay exhibits a decreased D_{001} peak with respect to an organoclay that is the reaction product of the smectite clay with a diester quaternary ammonium compound.

A4

9 12. (amended) The organoclay composition of claim [11] 8 10, wherein the diester [quat] quaternary ammonium compound is present as greater than 55 wt% of the quaternary onium compound mixture.

10 13. (amended) The organoclay composition of claim 9 12, wherein a triester [quat] quaternary ammonium compound is present and comprises less than 25 wt% of the quaternary onium compound mixture.

14. (amended) An organoclay composition in accordance with claim [13] 10, wherein the [quaternary ammonium compound is the reaction product] diester quaternary ammonium compounds, triester quaternary ammonium compounds, and monoester quaternary ammonium compounds are the reaction products of C_{12} - C_{22} fatty acids or the hydrogenation products thereof, or a mixture of such acids, with an alkanolamine in the presence of an acid catalyst, wherein the ratio of fatty acid to alkanolamine is from about 1.40 to 2.0.

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15. (amended) The organoclay composition of claim 14, wherein the fatty acids corresponding to the esters in the quaternary [mixture] onium compound mixture for the quaternary ammonium compounds have a degree of unsaturation such that the iodine value ("IV") is from about 20 to about 90.

16. (amended) The organoclay composition of claim 15, wherein the diester [quat] quaternary ammonium compound content is greater than 60 wt%, the triester [quat] quaternary ammonium compound content is less than 20 wt%, and the IV is from about 30 to about 70.

17. (amended) The organoclay composition of claim 16, wherein the diester [quat] quaternary ammonium compound content is greater than 62%, the triester [quat] quaternary ammonium compound content is less than 17 wt%, and the IV is from about 40 to about 60.

Please add the following claims:

31. A method for preparing a nanocomposite comprising:

contacting a smectite clay with a quaternary onium compound mixture comprising a diester quaternary ammonium compound mixed with a triester quaternary ammonium compound, a monoester quaternary ammonium compound, or mixtures thereof; and wherein the organoclay exhibits a decreased D_{001} peak with respect to an organoclay that is the reaction product of the smectite clay with a diester quaternary ammonium compound; and

intermixing an organoclay with a polymer matrix.

A5 cont.

32. The method of claim 31, wherein the organoclay comprises a diester quaternary ammonium compound present as greater than 55 wt% of the quaternary onium compound mixture.

33. The method of claim 31, wherein the organoclay comprises a triester quaternary ammonium compound present and comprises less than 25 wt% of the quaternary onium compound mixture.

Sub. B5

34. The method of claim 31, wherein the diester quaternary ammonium compounds, triester quaternary ammonium compounds, and monoester quaternary ammonium compounds are the reaction products of C_{12}-C_{22} fatty acids or the hydrogenation products thereof, or a mixture of such acids, with an alkanolamine in the presence of an acid catalyst, wherein the ratio of fatty acid to alkanolamine is from about 1.40 to 2.0.

35. The method of claim 34, wherein the fatty acids corresponding to the esters in the quaternary ammonium compound mixture for the quaternary ammonium compounds have a degree of unsaturation such that the iodine value ("IV") is from about 20 to about 90.

36. The method of claim 35, wherein the diester quaternary ammonium compound content is greater than 60 wt%, the triester quaternary ammonium compound content is less than 20 wt%, and the IV is from about 30 to about 70.

37. The method of claim 36, wherein the diester quaternary ammonium compound content is greater than 62%, the triester quaternary ammonium compound content is less than 17 wt%, and the IV is from about 40 to about 60.

38. The method of claim 37, wherein the IV is from about 45 to about 58.

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AS cont. 24 39. The method of claim 31 further comprising subjecting the smectite clay to a shearing treatment.

25 40. The method of claim 31 further comprising subjecting the organoclay to a shearing treatment.

26 41. The method of claim 31 wherein intermixing the organoclay with the polymer matrix comprises extruding the organoclay with the polymer matrix.

42. The nanocomposite of claim 1, wherein the D_{001} peak of the exfoliated organoclay is substantially absent.

43. The organoclay of claim 10, wherein the D_{001} peak of the organoclay is substantially absent when the organoclay is exfoliated into a polymer matrix.

44. The method of claim 31, wherein the D_{001} peak of the exfoliated organoclay is substantially absent .

RESPONSE TO OFFICE ACTION MAILED SEPTEMBER 7, 2000

A. Claims In The Case

Claims 1-30 have been rejected. Claims 2, 3, 11 and 21-30 have been canceled without prejudice. Claims 31-44 have been added. Claims 1, 2, 4-10, 12-20 and 31-44 are pending in the application. A clean copy of the pending claims is enclosed.

B. The Claims Are Not Anticipated By The Cited Art Pursuant To 35 U.S.C. § 102(b)

Claims 1-3, 10, 11, 21-23 have been rejected as being anticipated by U.S. Patent No. 5,718,841 to Mardis ("Mardis"). Applicant respectfully disagrees with the rejection.

The standard for "anticipation" is one of fairly strict identity. To anticipate a claim of a patent, a single prior source must contain all the claimed essential elements. *Hybritech, Inc. v. Monoclonal Antibodies, Inc.*, 802 F.2d 1367, 231 U.S.P.Q.81, 91 (Fed.Cir. 1986); *In re Donahue*, 766 F.2d 531, 226 U.S.P.Q. 619, 621 (Fed.Cir. 1985).

Applicant's amended claim 1 states:

> A clay-polymer nanocomposite comprising an organoclay which has been exfoliated into a polymer matrix, the organoclay being the reaction product of a smectite clay with a quaternary onium compound mixture, wherein the quaternary onium compound mixture comprises a diester quaternary ammonium compound mixed with a triester quaternary ammonium compound, a monoester quaternary ammonium compound, or mixtures thereof; and wherein the organoclay exhibits a decreased D_{001} peak with respect to an organoclay that is the reaction product of the smectite clay with a diester quaternary ammonium compound.

Mardis does not appear to teach all of the features in Claim 1, including but not limited to "an organoclay which has been exfoliated into a polymer matrix, the organoclay being the reaction product of a smectite clay with a quaternary onium compound mixture, wherein the quaternary onium compound mixture comprises a diester quaternary ammonium compound mixed with a triester quaternary ammonium compound, a monoester quaternary ammonium compound, or mixtures thereof; and wherein the organoclay exhibits a decreased D_{001} peak with respect to an organoclay that is the reaction product of the smectite clay with a diester quaternary ammonium compound."

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Mardis appears to teach an organoclay composition comprising a quaternary ammonium compound. Mardis, however, does not appear to teach or suggest the use of a specific mixture of ester derived quaternary ammonium compounds for preparing an organoclay composition with improved exfoliation of the clay platelets when compared to a diester quaternary ammonium compound. The use of a triester and/or monoester quaternary ammonium compounds with diester quaternary ammonium compounds imparts new, unexpected exfoliation of the organoclay in a clay-polymer mixture formed using the produced organoclay.

Applicant's Example 3 states, in part:

> an organoclay sample was prepared using the procedure of Example 1, except that in this instance the quat used was a diester quat (based on hydrogenated tallow), which in part differs from the quat used in Examples 1 and 2 in including methyl groups on the remaining two -N bonds, whereas the Example 1 quat includes a hydroxyethyl group on one of the said remaining -N bonds. A wide angle x-ray scan pattern for the product resulting from the reaction is shown in Figure 3. The 001 reflection peak indicates a D_{001} spacing for the organoclay of 39.5 Å, which is not as high as the sample of Example 1, although still suggesting that the organoclay will exhibit a reasonably high exfoliation efficiency in nanocomposites.
> (Page 17, lines 10-20)

Applicant's Example 1 was prepared in the same way as Example 3 except a mixture of quaternary ammonium compounds was used.

Applicant's Example 1 states in part:

> The 001 reflection peak indicates a remarkably high D_{001} spacing for the organoclay of 59.1 Å, and suggests that the organoclay will exhibit a very high exfoliation efficiency in nanocomposites.

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When a clay is added to a polymer resin, exfoliation may occur. Exfoliation is a term used to describe a process in which the individual clay platelets separate from each other. The degree of exfoliation may be determined by measuring the D_{001} spacing of the clay platelets using X-ray diffraction. X-ray diffraction gives a measurement of the spacing of the platelets. The greater the spacing distance, the weaker the D_{001} peak will be. The absence of a D_{001} peak indicates a high exfoliation of the organoclay.

Applicant's Example 2 states, in part:

> The D_{001} reflection peak of the organoclay is completely gone in this composite indicating very high exfoliation of the organoclay in the HIPS matrix.
> (Page 17, lines 6-8)

Applicant submits that a clay-polymer nanocomposite in which high exfoliation of the organoclay occurs is neither taught nor suggested by Mardis. While Mardis appears to teach the use of quaternary ammonium compounds, the specific mixture of quaternary ammonium compounds, as taught by Applicant's claim 1 is not taught in Mardis. Applicant further submits that Mardis does not inherently teach or suggest complete exfoliation. As given in Applicant's examples, the formation of an organoclay with a mixture of quaternary ammonium compounds exhibits complete exfoliation when added to a resin as in Examples 1 and 2.

Applicant's amended claim 10 states:

> An organoclay comprising the reaction product of a smectite clay with a quaternary onium compound mixture wherein the quaternary onium compound mixture comprises a diester quaternary ammonium compound mixed with a triester quaternary ammonium compound, a monoester quaternary ammonium compound, or mixtures thereof; and wherein the organoclay

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> exhibits a decreased D_{001} peak with respect to an organoclay that is the reaction product of the smectite clay with a diester quaternary ammonium compound.

Applicant's claim 10 and associated dependent claims are directed toward an organoclay composition wherein unexpected exfoliation of the organoclay in a polymer matrix occurs. As detailed in the argument of Applicant's claim 1, Mardis does not appear to teach or suggest the use of a specific mixture of diester derived quaternary ammonium compounds for preparing an organoclay with improved exfoliation of the clay platelets.

Applicant's claim 31 states:

> A method for preparing a nanocomposite comprising:
>
> contacting a smectite clay with a quaternary onium compound mixture comprising a diester quaternary ammonium compound mixed with a triester quaternary ammonium compound, a monoester quaternary ammonium compound, or mixtures thereof;
>
> intermixing an organoclay with a polymer matrix, wherein when the organoclay is exfoliated into a polymer matrix the organoclay exhibits a decreased D_{001} peak with respect to an organoclay that is the reaction product of the smectite clay with a diester quaternary ammonium compound.

Applicant's claim 31 and associated dependent claims are directed toward a method for preparing a nanocomposite in which the organoclay is exfoliated into a polymer matrix. Mardis does not appear to teach or suggest a method of preparing a nanocomposite wherein a specific mixture of diester derived quaternary ammonium compounds are used for preparing an organoclay composition with improved exfoliation of the organoclay in a polymer matrix.

C. <u>The Claims Are Not Obvious By The Cited Art Pursuant To 35 U.S.C. § 103(a)</u>

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Claims 1-30 were rejected as being unpatentable over U. S. Patent No. 5,718,841 to Mardis ("Mardis") in view of U.S. Patent No. 6,037,315 to Franklin ("Franklin").

To establish a *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 U.S.P.Q. 580 (C.C.P.A. 1974), MPEP § 2143.03. Further unrelated or nonanalogous prior art elements may not be utilized to establish obviousness. *In re Oetiker*, 977 F.2d 1443, 24 USPQ 2d 1443 (Fed. Cir. 1992).

Applicant's amended claim 1 states:

> A clay-polymer nanocomposite comprising an organoclay which has been exfoliated into a polymer matrix, the organoclay being the reaction product of a smectite clay with a quaternary onium compound mixture, wherein the quaternary onium compound mixture comprises a diester quaternary ammonium compound mixed with a triester quaternary ammonium compound, a monoester quaternary ammonium compound, or mixtures thereof; and wherein the organoclay exhibits a decreased D_{001} peak with respect to an organoclay that is the reaction product of the smectite clay with a diester quaternary ammonium compound.

For at least the same reasons cited above with regard to Mardis, Applicant submits that the combination of Franklin and Mardis does not teach all of the features of the independent claims 1, 10, and 31. Franklin also appears to teach mixing clays with quaternary ammonium compounds in non-aqueous compositions. Non-aqueous formulations of clay and quaternary ammonium compounds may preclude the reaction of the clay and the quaternary ammonium compound.

Franklin states:

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> Vehicles other than water that can be used in compositions according to the invention can include liquids or solids as emollients, solvents, humectants, thickeners and powders.
> (Col. 19, lines 28-30)

Franklin further states:

> Powders can include components such as chalk, talc, Fuller's earth, kaolin, starch, gums, colloidal silicon dioxide, sodium polyacrylate, tetra alkyl and/or trialkyl aryl ammonium smectites, chemically modified magnesium aluminum silicate, organically modified montmorillonite clay, hydrated aluminum silicate, fumed silica, carboxyvinyl polymer, cellulosics such as hydroxethyl cellulose and sodium carboxymethyl cellulose, ethylene glycol monostearate, zinc or magnesium stearate, zinc oxide and magnesium oxide.
> (Col. 19, lines 59-67)

Franklin does not appear to teach the reaction of a quaternary ammonium compound with a clay to produce an organoclay. Further, Franklin does not appear to teach an organoclay made with a mixture of quaternary ammonium compounds where the D_{001} peak is decreased with respect to an organoclay that is the reaction product of the smectite clay with a diester quaternary ammonium compound.

Applicant's amended claim 10 states:

> An organoclay comprising the reaction product of a smectite clay with a quaternary onium compound mixture wherein the quaternary onium compound mixture comprises a diester quaternary ammonium compound mixed with a triester quaternary ammonium compound, a monoester quaternary ammonium compound, or mixtures thereof; and wherein the organoclay exhibits a decreased D_{001} peak with respect to an organoclay that is

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> the reaction product of the smectite clay with a diester quaternary ammonium compound.

Neither Mardis nor Franklin appear to teach an organoclay made with a mixture of quaternary ammonium compounds where the organoclay exhibits a decreased D_{001} peak with respect to an organoclay that is the reaction product of the smectite clay with a diester quaternary ammonium compound.

Applicant's claim 31 states:

> A method for preparing a nanocomposite comprising:
>
> contacting a smectite clay with a quaternary onium compound mixture comprising a diester quaternary ammonium compound mixed with a triester quaternary ammonium compound, a monoester quaternary ammonium compound, or mixtures thereof;
>
> intermixing an organoclay with a polymer matrix, wherein when the organoclay is exfoliated into a polymer matrix the organoclay exhibits a decreased D_{001} peak with respect to an organoclay that is the reaction product of the smectite clay with a diester quaternary ammonium compound.

Applicant's claim 31 and related dependent claims are directed toward a method for preparing a nanocomposite in which the organoclay made with a mixture of quaternary ammonium compounds exhibits a decreased D_{001} peak with respect to an organoclay that is the reaction product of the smectite clay with a diester quaternary ammonium compound. Neither Franklin nor Mardis appear to teach such a method.

Claims 1-9 were rejected as being unpatentable over Mardis in view of Franklin and further in view of EP 952,187 to Ross. Applicant respectfully notes Ross was published on

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October 27, 1999. The filing date of the instant application is October 21, 1999. Ross may not be considered prior art and may not be relied upon to reject the present claims.

D. Summary

Based on the above, Applicant submits that all claims are now in condition for allowance. Favorable reconsideration is respectfully requested.

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Applicant respectfully requests a one month extension of time to respond to the Office Action dated September 7, 2000. A Fee Authorization form in the amount of $182.00 is enclosed for the extension of time fee and four additional dependent claims. If any further extension of time is required, Applicant hereby requests the appropriate extension of time. If any fees are inadvertently omitted or if any additional fees are required or have been overpaid, please appropriately charge or credit those fees to Conley, Rose & Tayon, P.C. Deposit Account Number 50-1505/5628-00400/EBM

Respectfully submitted,

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